EGU22-3160
https://doi.org/10.5194/egusphere-egu22-3160
EGU General Assembly 2022

A semblance based microseismic event detector for DAS data

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Distributed Acoustic Sensing (DAS) is becoming increasingly popular in microseismic monitoring operations. Fiber-optic cables such as conventional telecommunication or built-for-purpose cables can be turned into a dense array of geophones that samples seismic wavefields continuously for several kilometers. DAS is particularly interesting for microseismic monitoring of geothermal systems since it does not have the same temperature limitations as standard electronic equipment. The sensing fiber can therefore be installed at high-temperature reservoir conditions and in the same well that is being stimulated. Because of these advantages, the distance between the detecting sensor and the induced seismicity can be minimized, maximizing the detection capability. Typical DAS acquisition samples the wavefield at about 1 m spacing and sampling frequencies of 1 kHz or higher. Unfortunately, standard seismological techniques are not capable of exploiting this high spatial density of sensors, hence they are ineffective in processing this kind of data. Here we propose a semblance-based seismic event detection method that fully exploits the characteristics of the DAS data. The detection identifies seismic events by looking at waveform coherence along hyperbolas while changing the curvature and position of the vertex. The method returns a time series of coherence values and, if these values are higher than a determined threshold, it catches a seismic event. First we test the detector with synthetic data resembling a realistic setup. Finally, we validate the detector by applying it to real DAS data from the Utah FORGE site in the US. This work is supported by the EU-Geothermica DEEP project.